



5.4.10 Thunderstorms / High Winds

History

At least 170 significant thunderstorm events were identified in Arizona between 1970 and 2006, 14 of which prompted a disaster declaration. Each of these events caused at least one injury, one death, \$50,000 worth of damage, or was severe enough to be identified in historical records. It should be noted that the events detailed in this section are all associated with thunderstorms in some fashion, but may also appear as a significant event in another hazard profile. For example, the microburst that occurred on August 14, 1996 involved various documented severe weather events including damage caused by high wind, flooding, and hail. Specific event histories of these hazards are provided throughout the various chapters of this document. Most of the significant thunderstorm events were identified using the National Climate Center (NCDC) Storm Event Database, which has a large number of well-recorded events from approximately 1970 forward. For all 170 events, 20 deaths, 189 injuries, and \$420.2 million in damages were recorded. These events include the following:

- June 15, 1972, severe thunderstorms were accompanied by heavy precipitation that caused flooding throughout Phoenix and Scottsdale. The storms caused two fatalities, \$8 million in damage from flooding, and led to a Gubernatorial emergency declaration (ADEM, March 6, 2003).
- August 27, 1988, a severe thunderstorm caused two deaths and injured 17 in Pinal County (NCDC Storm Event Database).
- June 26, 1990, a severe thunderstorm in Gila County caused six fatalities (NCDC Storm Event Database).
- August 5, 1993, a severe thunderstorm in Avondale resulted in 1 injury and \$5 million worth of damages. Strong winds from nearby thunderstorms exceeded 50 mph in many areas of the Valley. Homes and businesses sustained damage, trees were uprooted and power lines were downed. Arizona Public Service reported 10,000 customers without power. An 8-year-old boy in Avondale was severely injured after a window burst and glass cut his jugular vein. The roof of a convenience store was blown off, as well as some damage to a church and an elementary school. A 1-mile section of a 69,000-volt power line near Perryville was knocked down. High winds blew tree limbs onto power poles and took shingles off several homes (NCDC Storm Event Database).
- August 9, 1992, in Tucson, roofs were blown off, trees uprooted, and power interrupted to some 20,000 customers. Power poles were snapped by high winds on the west side of the city. Winds reached as high as 60 mph at the NWS in Tucson. A total of \$5 million property damage was recorded (NCDC Storm Event Database).
- August 11, 1995, a series of strong thunderstorms moving through Tucson brought widespread damage. Many power poles were knocked over with roofs torn off some buildings. As much as four inches of rain accompanied these storms. Some areas received three-quarters inch hail. Washes in the area were running near bank full. One woman attempting to drive through a wash was swept to her fatality. Damage was estimated at \$5 million (NCDC Storm Event Database).
- August 14, 1996, every town in the north and western half of the Phoenix Metropolitan Area reported some damage due to a severe thunderstorm and microburst. Severe thunderstorms moved from Crown King rapidly southwestward across the west valley, producing widespread damaging winds and very heavy rainfall. The hardest hit areas were in northwest Phoenix, Glendale, and Peoria. Other towns that sustained damage were Sun City, Surprise, El Mirage, Tolleson, Avondale, Goodyear, and Buckeye. Approximately 400 power poles were knocked down throughout these towns, 100 owned by SRP and 300 owned by APS. An Arizona record wind gust of 115 miles per hour was recorded at the Deer Valley Airport. There were from 70,000 - 75,000 homeowner claims and an estimated \$160 million in damage. Numerous minor injuries were also recorded (NCDC Storm Event Database, National Weather Service - Phoenix).
- September 19, 1999, microburst winds struck the Desert Sands Trailer Park, destroying at least 14 homes and damaging 340 homes. Over 200,000 customers lost power after more than 40 power poles were snapped by the winds and rain. Talley Industries, on Greenfield Road received about \$500,000 in damage as a large portion of the roof was removed by wind. A large truck was overturned near 80th Street and Baseline Road. Trees were uprooted in nearby Gilbert. A total of 2 injuries and \$3 million property damage were reported (NCDC Storm Event Database).
- July 14, 2001, a microburst hit Scottsdale and Tempe with very strong winds and heavy rain. Many homes and businesses sustained damage, with at least 19 power poles blown down. One pole landed on a vehicle near Scottsdale and Indian Bend roads, killing the driver. About 6,000 residents were left without power, including the nearby Radisson Resort. Winds ripped the roofs off four homes in the McCormick Ranch area, and dumped them up to two blocks away. Numerous trees were uprooted. A total of 1 fatality and \$5 million property damage were reported (NCDC Storm Event Database).



- July 14, 2002, two microbursts struck the Phoenix area. Winds from the first microburst heavily damaged the Arizona Public Service power sub-station at 7th Ave & Thomas. Widespread damage was reported across the greater Phoenix metropolitan area caused by the storm's high winds and heavy rainfall with up to 2 inches in 90 minutes. Utility companies reported that 22 power poles were downed, leaving at least 47,000 homes and businesses without electricity for many hours. Homes in Scottsdale and Ahwatukee were struck by lightning and set on fire. The microburst caused an estimated \$20 million damages (NCDC Storm Event Database).
- That same day, a second of microburst event struck Sky Harbor Airport at the Postal facility and the West economy parking lot. A large thunderstorm complex, with strong microburst winds estimated at 100 mph struck Sky Harbor International Airport. Southerly winds and dense blowing dust initially spread across the East valley and converged with a fast-moving thunderstorm in North Phoenix. These merging systems developed into a severe thunderstorm with winds that uprooted trees, took down power poles and damaged homes and businesses near the airport. Several hangars sustained major damage. Flying debris damaged five commercial aircraft, several private planes and hundreds of cars in the nearby parking lots. Numerous flights were diverted during the overnight hours due to the debris that was scattered on the runway. Property damage was reported at \$30 million (NCDC Storm Event Database).
- August 22, 2006, strong thunderstorm winds, probably from a microburst, knocked down approximately 50 power poles in Glendale, just west of Phoenix, leaving 18,000 people without power and causing \$200,000 of property damage. Shingles were torn off roofs and flagpoles were napped.

Map 30

Data provided by the National Climatic Data Center included records of events that caused damage or injury for each county in Arizona. Most of these recorded events have occurred where populations are at risk and observers and reporting are most readily available. Therefore, the actual occurrence and frequency of Thunderstorm/High Winds in general, is not represented in this map.

Probability and Magnitude

Thunderstorms occur throughout the year in Arizona, but most commonly during the monsoon season, the seasonal wind shift that brings a dramatic increase in moisture. Severe thunderstorms produce heavy rain, flash flooding, severe winds, hail, and lightning. Rainfall is the most recognizable attendant feature of thunderstorms, with normal annual precipitation rates varying greatly across Arizona, from as little as 3 inches per year in Yuma to nearly 23 inches in Flagstaff and posing a significant flash flooding hazard. Severe thunderstorms may also produce hail. Another hazardous feature of severe thunderstorms is tornadoes, which are generally rare in Arizona and relatively weak, but may cause damage. Lightning is a hazard wherever and whenever thunderstorms occur, but can be particularly hazardous in those areas highly susceptible to wildland fires.

One thunderstorm feature, microbursts, generate localized, straight-line winds reaching from 60 to over 100 mph. Microbursts are quite common in Arizona, cause significant damage and are frequently the cause of high wind events. On rare occasions thunderstorms can develop much larger "macroburst" winds that have an affected outflow area of at least 2.5 miles wide and peak winds lasting between 5 and 20 minutes. Intense macrobursts may cause tornado-like damage (NWS Phoenix).

The probability of a severe thunderstorm occurring increases as the average duration and number of thunderstorm events increases. The NWS collects information on the number of thunder days (days with a thunder clap), number and duration of thunder events, and lightning strike density. Unfortunately these data are only available at the NWS forecast office sites and other airport locations. The airport locations have too short of a record to determine the geographical extent of thunderstorms. We explored the use of a lightning flash density map as a proxy for the geographical distribution of thunderstorms. However, the lightning density is most extreme in the higher elevations, which in most cases are not areas most at risk for thunderstorm events, with the exception of lightning-caused wildfires. The lightning flash density map did not adequately reflect the thunderstorm risk in the lower deserts. Instead, we chose to map the average annual number of thunderstorm damage reports by county, as noted in the NCDC Storm Event Database between 1970 and 2006. The majority of storm damage reports are in the major urban areas of metropolitan Phoenix, Tucson, Yuma, Prescott, Kingman and the lower Colorado River communities of Lake Havasu and Bullhead City in Mohave County. While severe thunderstorms occur everywhere in the State, the population centers are the most at risk from storm damage.

The duration of thunderstorms in Arizona is among the longest in the nation. An area stretching northwest from Flagstaff to the junction of the Arizona, Utah, and Nevada borders has an average annual thunderstorm duration of 110-130 minutes. The minimum average duration time for thunderstorms in Arizona is 70 minutes, although individual storm cells may last less than 30 minutes before a new cell propagates.

Despite the long duration time, the highest number of thunderstorms on average in Arizona is 70-80 annually, again concentrated north of Flagstaff to the Arizona-Utah border. This is significantly lower than in the Southeastern US, but is largely due to the concentration of most thunderstorms in Arizona during the summer monsoon season.



Lightning strikes are another indicator of thunderstorm hazard. Two concentrations of lightning strikes are apparent in one again in northern Arizona and another in southeastern Arizona which, respectively, have 14-16 and 12-14 lightning strikes per square kilometer annually.

In an attempt to categorize the probability of future thunderstorm/high wind events, the hazard was analyzed using the CPRI. This method also takes into account the levels of magnitude/severity, warning time and duration. In Arizona, thunderstorm/high winds are highly likely, the magnitude/severity is typically critical, the warning time is 6 -12 hours and the duration is usually less than 6 hours. These factors resulted in a CPRI rating of 3.25. The highest rating a hazard can result in using this method is 4.

Vulnerability

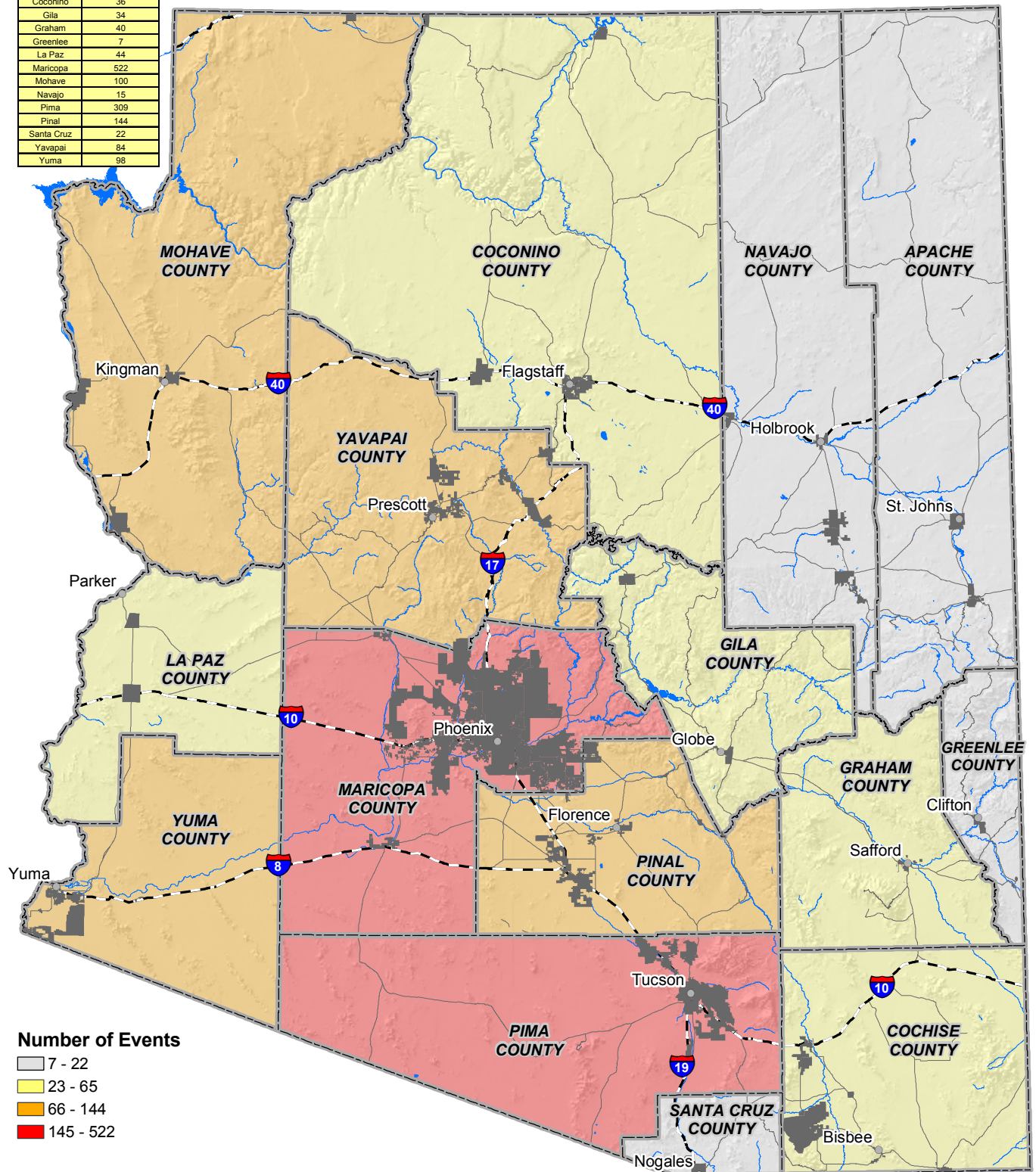
The entire state is assumed to be equally exposed to the non-flood damage risks associated with thunderstorms. Typically, incidents are fairly localized and damages associated with individual events are relatively small. According to the National Weather Service, the State of Arizona typically endures 60 to 70 thunderstorm events per year. A review of the historic hazards from 1970 to 2003 would indicate that a severe thunderstorm or high wind event has the capacity to do at least \$430 million dollars in damage. Some storms moving over the Phoenix metro area to the north, have caused \$20 to \$30 million dollars in damages in a single event. Historically, 18 fatalities and 193 injuries have resulted from thunderstorm related events within Arizona (URS, Oct 2003).

For the local risk assessment summary, the table below combines asset and predominantly HAZUS information for the estimated losses as reflected in local plans. The potential total number of facilities in the hazard areas is 1,225,149 at a replacement cost of \$238 billion. The estimated losses for the hazard areas are approximately \$223 million.

Summary of Local Risk Assessment & Loss Estimates based on Thunderstorms/High Winds			
	Total Assets \$ (Assets +HAZUS) x \$1,000	# of Facilities Impacted (Assets + HAZUS)	Estimated Loss
Statewide Totals	\$238,965,224	1,225,149	\$223,653,000
Apache	-----	-----	\$70,000,000
Cochise	-----	-----	\$300,000
Gila	-----	-----	\$400,000
La Paz	-----	-----	\$300,000
Maricopa	\$188,380,403	994,383	\$1,231,000
Mohave	-----	-----	\$470,000
Pima	\$50,584,821	230,766	\$952,000
Pinal	-----	-----	\$70,000,000
Yavapai	-----	-----	\$80,000,000
----- Denotes lack of available information for assessment.			

State of Arizona

COUNTY	STORM EVENTS
Apache	10
Cochise	65
Coconino	36
Gila	34
Graham	40
Greenlee	7
La Paz	44
Maricopa	522
Mohave	100
Navajo	15
Pima	309
Pinal	144
Santa Cruz	22
Yavapai	84
Yuma	98

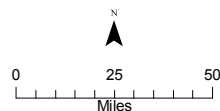


Note: The National Climatic Data Center's Storm Data database lists "Thunderstorm/High Winds" for which damage or injury reports were filed.

Source: State of Arizona Climate Office 2007; NCDC 2006; ALRIS 2006; URS 2003

Legend

- Major City
- County
- interstate
- Lakes
- Highway
- Cities
- Major Streams



August 2007



State of Arizona Multi-Hazard Mitigation Plan

Map 30 Thunderstorm Damage Events by County 1970 thru 2006

